

High enhancement of Eu^{3+} luminescence in SrAl_4O_7 phosphor by means of charge compensation with Na^+ ions.

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A comparative study of the luminescent properties of $\text{SrAl}_4\text{O}_7:\text{Eu}^{3+}(x\%)$ and $\text{SrAl}_4\text{O}_7:\text{Eu}^{3+}(x\%),\text{Na}^+(x\%)$ ($x=0.002$ to 0.1) phosphor powders as a function of activator concentration is reported. Upon UV excitation both series of compounds exhibit strong characteristic red Eu^{3+} photoluminescence with a maximum around 611.5 nm, which intensity increases with an increase of activator content. It was found that the luminescence spectra of singly Eu^{3+} doped strontium aluminate are much more concentration dependent. As the dopant content increases, the spectra of $\text{SrAl}_4\text{O}_7:\text{Eu}^{3+}$ show an increased line broadening and the emergence of new emission components. The observed changes in the studied concentration range are due to an increased disorder of Eu^{3+} local symmetry induced by the increase in the number of defects in host lattice and by the presence of a new crystalline phase that occurs at the higher dopant content. Charge compensation through Na^+ co-doping facilitates an incorporation of Eu^{3+} into the SrAl_4O_7 lattice and leads to a smaller symmetry disorder of activator surroundings as well as a significantly enhanced Eu^{3+} luminescence intensity. The largest increase in emission intensity (~6.5 times) was observed for 7%-doped sample. Concentration dependences of the luminescence kinetics of both types of materials are clearly different. It was found that for singly Eu^{3+} doped SrAl_4O_7 the 5D₀ lifetime shortens with the increase of activator content from 1.8 to 1.4 ms while for Na^+ co-doped SrAl_4O_7 this value does not vary over a range of concentrations and is approximately 1.8 ms. $\text{SrAl}_4\text{O}_7:\text{Eu}^{3+},\text{Na}^+$ powders are potential candidates to be used as luminescent materials.

Słowa kluczowe

SrAl_4O_7 , Eu^{3+} -doped, charge compensation, luminescence, decay kinetics

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